EP0308118

DOOR ACTUATOR

The invention relates to a door actuator, particularly a door lock, of rail vehicles, having a spindle drive whose spindle is connected with a freewheel permitting the rotation of the spindle in the direction corresponding to the closing direction of the door and preventing the rotation of the spindle in the direction corresponding to the opening direction, the part of the freewheel away from the spindle being mounted in a rotatable manner but being releasably fixed with respect to a release device against the force of at least one contact pressure spring by means of a clutch, brake or the like, which can be released by means of a lifting magnet, and the brake, clutch or the like is fixed or can be fixed in its open position.

Such a door actuator according to the preamble of Claim 1 is known from U.S. Patent Document US 3,745,705 A. A swinging-sliding door is described therein whose drive takes place by way of a spindle moving a door leaf by way of a nut. The freewheel connected with the spindle permits the movement of the door leaf in the closing direction but prevents a movement in the opening direction. A gearwheel connected with the freewheel can be locked by way of a locking pawl which can engage in the indentations of the gearwheel. This takes place in the closed

position of the door. In order to permit the opening of the door, the locking pawl is moved by means of a magnet into a position releasing the gearwheel, whereby the freewheel as a whole can be rotated about the spindle axis. By means of a holding bar, the locking pawl is fixed in the position releasing the gearwheel, whereby a de-energizing of the magnet becomes possible during the opening and closing of the door. During the entire opening and closing operation of the door, the locking pawl remains in the released position. Only immediately before the door edges mutually abut or abut on a door frame during the closing, will the holding bar be displaced by a pin moved together with the door leaf, whereby the locking pawl engages in the gearwheel. As a result of the freewheel, despite the locked gearwheel, an

end position can now be reached which is acted upon by tension for the purpose of an optimal tightness.

British Patent Document GB 2 283 054 A and International Patent Document WO 95/09959 describe a swinging sliding door whose drive takes place by way of a spindle moving the door by way of a nut. The end of the spindle facing away from the drive is connected with a receiving device by way of a freewheel. The freewheel permits the rotation of the spindle in the direction corresponding to the closing movement of the door, even when the receiving device is held. This receiving device is optionally non-rotatably or rotatably disposed under the effect of a brake or clutch. By way of a shaft, the receiving device is connected

AMENDED PAGE

with a clutch disc. A rod acts upon two opposite discs which are non-rotatable with respect to the car body and axially displaceable with respect to the shaft. When the rod is displaced in the defined direction, the clutch disc and therefore also the receiving device are released, whereby an opening of the door is permitted. In the normal operation, this release takes place by a solenoid or, in an emergency, by means of a Bowden cable. The brake or clutch remains released as long as the solenoid is acted upon by current. When the current is interrupted, the brake or the clutch is moved into the non-released position by means of springs.

Numerous rail vehicles have door actuators which contain a spindle drive. In order to permit a closing of the door at any time, also a manual closing, a freewheel is arranged on one end of the spindle, which freewheel permits the rotating of the spindle in the direction corresponding to the closing movement of the door, but prevents a rotating of the spindle in the direction corresponding to the opening movement. In order to nevertheless be able to open the door, the part of the freewheel away from the spindle is rotatably mounted with respect to the body and is generally fixed by a brake, a clutch or the like. When now the door is opened in the course of the normal operation, this brake, clutch or the like is released by a lifting magnet so that the door actuator can rotate the spindle in the direction corresponding to the opening movement of the door, in which case

AMENDED PAGE

it naturally takes along the entire freewheel. If a manual opening occurs in emergency and danger situations, this brake, the clutch or the like can be released by the door emergency handle and the door can be opened manually.

These doors have been very successful during the operation and, particularly, because of their compact construction, their robust method of operation and their operational reliability, represent a wide-spread standard solution for the doors of rail vehicle.

The lifting magnet represents a certain disadvantage of doors of this type. It has to be activated during each opening of the door for the entire opening time and therefore has to be designed for fairly long operating periods. Since it also has to overcome considerable forces, it is necessary to provide a correspondingly sturdy and therefore large, expensive and current-requiring lifting magnet.

In addition, in the parked condition of the cars, thus, when the door actuator is without current or power, it is difficult for cleaning personnel or inspection personnel to enter the vehicle because, for this purpose, the emergency door handle has to be operated which extends to the outside at a relatively inaccessible point. On the inside, the emergency door handle is naturally provided in the direct vicinity of the door.

AMENDED PAGE

According to today's demands, many railroad administrations require that the door actuator has to have an accumulator, in practice, always a condenser which, even 24 hours after the parking of the vehicle, permits the releasing of the brake, clutch or the like by operating a corresponding button and thus the opening of the door. This results in problems when a door is closed again after the opening because, for the opening, a releasing of the brake, the clutch or the like is required under all conditions, but during the second attempt, the condenser is usually already empty.

It is therefore an object of the invention to provide a device by means of which, in the case of a door actuator of the initially mentioned type, the above-mentioned problems do not occur and it becomes possible, in particular to be able to satisfactorily use smaller lifting magnets and to open the door several times by means of the energy stored in the conventional condensers.

According to the invention, these objects are achieved in that a closing magnet for locking the brake, clutch or the like is provided. As a result, the brake or clutch can be moved into the locked position at any time, whereby a movement of the door in the opening direction is prevented.

An embodiment of the invention is characterized in that the

AMENDED PAGE

closing magnet and the lifting magnet are constructed in the form of a double-acting magnet. In this case, simple small double-acting magnets can be used.

In a further variant, the fixing takes place by means of a linkage for the movement of the brake, or clutch or the like which, in the course of the release movement, is guided by way of a dead center. Thus, despite the contact pressure spring, the brake or the clutch will also remain in the open position when the lifting magnet is de-energized.

In another variant, the brake, clutch or the like or a magnetizable component connected therewith, in the open position, is caused to approach a permanent magnet such that its attraction force will hold the brake open against the force of the contact pressure spring also when the magnet is de-energized.

In this manner, the activating of the lifting magnet is required only during the releasing or locking movement of the brake, clutch or the like, but not for the holding in the open position, and therefore small double-acting magnets can be used which permit several opening operations also by means of conventional condensers.

In the following, the invention will be explained in detail with reference to the drawing.

AMENDED PAGE

Figure 1 is a sectional view of a device according to the invention in its released position along Line I-I of Figure 2;

Figure 2 is a sectional view of the device of Figure 1 rotated by 90° with respect to that of Figure 1;

Figures 3 and 4 are sectional views of the device according to Figures 1 and 2 in the locked condition; and

Figures 5 and 6 are views of variants of the invention with permanent magnets.

The drawing shows one of the ends of a door actuator of the above-mentioned type in the area of the pertaining release device 2. A spindle 1 of the door actuator, which is connected with the (not shown) end of the freewheel, of the brake, or the like away from the door, which as the above-explained function, carries a toothed spindle disc 6 in a non-rotatable manner. In the illustrated embodiment, the release device 2 consists of a toothed disc 3 which is non-rotatably but axially displaceably arranged with respect to the car body 4 and is pressed by means of contact pressure springs 5 in the direction of the axis 7 of the spindle 1 against the toothed spindle disc 6.

In order to permit the opening of the door, it is know from the prior art to provide a lifting magnet 8 in the case of the

AMENDED PAGE

release device 2, which lifting magnet 8, by means of a mechanism which, as a whole, is called a linkage or lever 9, moves the non-rotatable toothed disc 3 against the force of the contact pressure springs 5 axially so far away from the toothed spindle disc 6 that, as illustrated in Figure 1, the combs of the toothing have little play in the axial direction with respect to one another,